

How Californians Are Dealing with Water Shortages

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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How have social groups in California responded to water shortages resulting from more frequent and intense droughts?

California has a unique relationship with water. Home to over 39 million people spread across 160 million square miles, the vast array of climates and population distribution mean that California must carefully balance its water usage. Areas of Northern California can see over 100 inches of precipitation per year, while regions of Southern California only receive a few inches (Water Education Foundation, 2021). However, over half the population lives in the southern counties colloquially known as “SoCal,” meaning the populous and arid South must source much of their water from hundreds of miles away (U.S. Census Bureau, 2020). These differences set the stage for government agencies, water distributors, agricultural industries, environmental advocacy groups, and local communities to respond and interact with each other differently regarding water supplies. Climate change threatens to increase the frequency and intensity of droughts in the entire state, and drought-induced water shortages will affect how these social groups respond to the shortage and interact with each other.

SoCal has already experienced the ramifications of its water demands vastly outweighing its water supplies, most recently during the 2012-2016 drought and the ongoing drought starting in 2020. To compensate for water scarcity, communities will often turn to increasing groundwater usage, especially during droughts. This overdrafting has led to most of California’s Central Valley to experience chronic groundwater depletion over the past decades (Alam et al., 2021). Exacerbating this issue, California’s lucrative agricultural industry demands a large chunk of California’s water each year. An estimated 40% to 80% of California’s total water supplies are used in agriculture, so despite the intensity or duration of a drought, the agricultural industry and its water supplies will be significantly impacted (Johnson and Cody, 2015). Government

agencies enact policies to protect and manage water supplies, but must avoid overstepping legal boundaries.

Clearly, water access will remain a hot-button issue in California for the foreseeable future. Different social groups have competing ideas on how to best manage California's water supplies, but some groups have found ways to work together during previous droughts.

Ultimately, the actions taken during and after recent California droughts can be applied to other drought-prone regions in the world to mitigate drought-induced water scarcity.

Methods

This paper primarily employs documentary research, where social groups are identified and studied to answer a research problem. The data from these social groups are interpreted and organized in a manner that supports the research problem, which required extensive review of existing literature and primary sources. The UVA library provided access to paywalled journals and articles through databases like JSTOR and Web of Science and newspapers like the New York Times. Advocacy groups often have their own websites and social media pages, and these provided much of the material required to discern their purpose, goals, and means. Local, state, and national news organizations were used to acquire information on events surrounding California water shortages.

Literature Review

California's environmental conditions are precarious and not expected to improve in the future. Woodhouse et al. (2020) found that perfect droughts, where all of a region's water sources experience drought at once, are expected to increase in frequency and duration in SoCal. Shukla et al. (2014) note the region's rising temperatures will also increase drought intensity, further reducing the area's water supply. California's highly productive Central Valley partially relies on

groundwater to alleviate drought-induced water scarcity, but little is known about the recovery rate of drought-induced groundwater depletion. Alam et al. (2021) discovered less than a third of the overdraft was recovered during post-drought years, putting much of the population at risk of future water scarcity.

After the 2012-2016 drought, the California Natural Resources Agency (CNRA) released a report detailing the state's response and the lessons learned, noting that each facet of the response required multiple government agencies, departments, and/or boards to work together to respond effectively. However, Citrin and Stoke (2018) found that public trust in government institutions in the US has declined, which may limit public support for the policy responses that water shortages require. Californian interest groups have already collaborated on litigation against regulatory agencies, forcing these agencies to roll back particularly strong policies.

Furthermore, water scarcity is expected to increase worldwide. The United Nations Children's Fund (UNICEF) and the Pew Charitable Trusts both estimate around half of the world's population will be living in water scarce regions by 2025 (Famiglietti, 2019). Semiarid regions like the Southwestern United States are at particular risk, as climate change will increase the frequency and duration of drought periods (Carrão and Barbosa, 2016). The lessons learned from California droughts will be relevant and pertinent worldwide.

Results and Analysis

Government Agencies and Departments

Like any large government, California has several political bodies that intertwine and interact in complicated and numerous ways. Often, these government agencies are means through which other participants advance their agendas, but some operate and manage major

statewide water projects. Despite the complexities of modern governments, a few major regulatory bodies that control California's water can be identified.

The California State Water Resources Control Board (CSWRCB), a branch of the California Environmental Protection Agency, guides regional water control boards and oversees statewide water rights, disputes, protection plans, and quality standards (CSWRCB, 2018). During the mid 2010s drought, the CSWRCB took a variety of actions to help combat the drought, primarily by restricting water diversions from the several river watersheds (CSWRCB, 2021). For the current drought that began in 2020, the CSWRCB has continued to do the same, along with issuing letters and notices detailing contingency and conservation plans, planned water curtailments, and more (CSWRCB, 2022).

The California Department of Water Resources (CDWR), a department of the California Natural Resources Agency, manages California's water resources, overseeing the development and renewal of the California Water Plan and protecting and restoring the Sacramento-San Joaquin River Delta. The CDWR also plans, designs, constructs, operates, and maintains the California State Water Project (SWP), a water storage and delivery system that provides clean water to 27 million Californians and 750,000 acres of farmland, aids in water management during floods and droughts, and generates hydroelectric power (CDWR, n.d.). From the CNRA's 2012-2016 drought report, the agency detailed the vast effects of legislative and regulatory actions taken during the drought (CDWR & Jones, J., 2021). Key takeaways from the drought included providing longer lead times for state financial aid to local agencies, practicing ongoing drought preparedness and response work, and better recording of wildlife needs (CDWR & Jones, J., 2021).

The federal government is also heavily involved in California's water management. The United States Bureau of Reclamation manages the Central Valley Project (CVP), another water storage and delivery system that provides water for a third of the farmland and a million households in California (USBR, 2021). Since the CVP and SWP both carry water in similar areas, operations between the two projects are coordinated based on multiple agreements. However, both projects come under severe strain during droughts. This was best exemplified in 2014, when the SWP allocated only 5% of its requested contractual quantity and the CVP allocated no water to its agricultural contractors (CNRA, 2021).

Water Distributors

Water distributors, who deliver water to the general public, are also important participants in this issue. These organizations often own the aqueducts, filtration plants, and reservoirs required for safe and efficient water distribution. These groups also often contract out to or source from the SWP or CVP. The Metropolitan Water District of Southern California (MWD) is a regional wholesaler that owns and operates the 242 mile long Colorado River Aqueduct and multiple water treatment plants. In turn, MWD sells this water to 26 member agencies, such as the City of Los Angeles and the San Diego County Water Authority, which supplies 19 million Southern Californians with potable water (MWDSC, 2020). During the mid 2010s drought, supplies from the Colorado River were relatively unaffected due to its vast reservoirs, which allowed the MWD to lean more on water from the Colorado River while the rest of its water sources were strained (CNRA, 2021). Keeping a diverse water supply will help the MWD continue to mitigate water scarcity during future droughts. The Los Angeles Department of Power and Water (LADWP) provides water for Los Angeles and surrounding communities and operates the Los Angeles Aqueduct System. The San Francisco Public Utilities Commission

(SFPUC) provides water for the City of San Francisco and surrounding communities and operates the Hetch Hetchy Aqueduct. The East Bay Municipal Utility District (EBMUD) provides water for the eastern side of the San Francisco Bay and operates the Mokelumne Aqueduct. By law, these distributors release an Urban Water Management Plan every five years to predict and plan for water demands and supplies in various conditions. In their 2020 plans, most include a multi-level water shortage contingency plan, data on existing water supplies, water demand predictions, water conservation efforts, and predictions on future water supplies (LADWP, 2021; EBMUD, 2021; SFPUC, 2021).

Environmental Advocacy Groups

Pro-conservation environmental advocacy groups look to ensure California's water is used responsibly and in a manner that will conserve the state's natural resources and ecosystems. To publicize California's water issues, the Water Education Foundation (n.d.) publishes research and hosts tours and conferences. The California Water Impact Network (n.d.) publishes research on California's water issues, but primarily pursues litigation. The California Sportfishing Protection Alliance (n.d.) pursues litigation and conducts habitat restoration projects. AquAlliance (n.d.) pursues litigation and documents well monitoring in Butte, Colusa, Glenn, and Tehama counties. In 2015, CSWRCB approved a series of Temporary Urgency Change Petitions (TUCPs) that relaxed salinity standards to divert more water from the Sacramento-San Joaquin River Delta, or California Delta, for agriculture. In response, CSPA, C-WIN, and AquAlliance jointly sued, prevailing in 2020. The settlement requires CSWRCB to comply with the Public Trust Doctrine for California Delta Plan requirements and TUCPs, implement a temperature management process for the Sacramento River, and consider California Fish and Game Laws for fish below dams (CSPA, C-WIN, & AquAlliance, 2020).

Agricultural Interests

In California, the agricultural industry is water-intensive, politically influential, and extremely profitable. Medellín-Azuara and Lund (2021) noted that agriculture accounts for over 400,000 full-time jobs in California. According to the CDWR, California crops used an average of 2.97 acre feet of water per acre, where an acre foot is the amount of water required to cover an acre of land in a foot of water or around 326,000 gallons. Almonds and pistachios were the second most water intensive crops, averaging 4.49 acre feet per acre in 2015, followed by alfalfa, citrus and subtropical fruits, sugar beets, other deciduous fruits, cotton, onions and garlic, potatoes, and vineyards (Pera, 2021). California's almond industry is particularly lucrative, producing 80% of the world's almonds and generating \$6 billion annually. Combined with its water intensity, almond production ends up being one of the largest uses of water in the state. Interestingly, the most water-intensive crop was "Pasture", which was the CDWR's catch-all term for grasses. In the eyes of Californians, this water use is probably justified, as "nearly 85 percent of all [agricultural] employment and revenues are from growing fruits, nuts and vegetables, which are about half of California's irrigated acreage" (Medellín-Azuara and Lund, 2021).

Despite the priorities of the farming industries, the individuals that sustain these industries often have a different mindset. A 2013 study from University of California, Davis found that perceived climate change risks, previous climate change experiences, and past environmental policy experiences will influence farmers' climate change beliefs and climate policy risk responses. However, the study also found that farmers were still just as likely to participate in a government incentive program to respond to climate policy risks even if they had negative policy experiences in the past. In support of this, a farmer was quoted saying "I think

agriculture is probably one of the most important industries today that has the ability to make the most difference in climate change and greenhouse gasses. But you have to incentivize it for the producers and the farmers. You need the carrot and not the stick.” (Niles et al., 2013). However, the current drought has still forced some farmers to take drastic actions. For example, some farmers tore out almond trees for less water-intensive crops (Nuccitelli, 2021). Joe Del Bosque, a farmer in the San Joaquin Valley, left a third of his farmland unplanted to save water for his almond trees, and may still need to uproot 100 of his 600 acres of almond trees. Jim Jasper, who owns Stewart & Jasper Orchards, noticed that many of his neighbors stopped irrigating their almond orchards altogether, saying “There's one orchard here that's drying up because they just didn't have the money to buy the water. And we're seeing this all over the valley” (Associated Press, 2021).

Ordinary Citizens and Local Communities

Many drought-afflicted California residents are also striving to secure their access to water. In Northern California, water diversions can dry up vital local creeks. According to a Shasta County resident: “We have no water for fire suppression and the fish and wildlife are dying. We have put out water for the wildlife near our property” (Becker, 2021). During the 2012-2016 California drought, 2,600 households in small, rural communities reported losing access to water because their wells ran dry. Many of these same households are in regions experiencing drought in 2021 (Escriva-Bou & Pauloo, 2021). To avoid losing water access, California’s urban customers will often pay premiums, with a 2016 report by Buck et al. finding that there is a household-level willingness to pay \$60-600 depending on the water shortage size and location to avoid annual disruptions in service.

Discussion

Water scarcity will be one of the most challenging issues facing humanity in the 21st century. UNICEF notes that two billion people live in countries with inadequate water supply, four billion people experience severe water scarcity for at least one month every year, and 700 million people could be displaced by water scarcity by 2030 (UNICEF, n.d.). From the recent droughts in California, a few potential ways to mitigate water scarcity are notable.

Schwabe and Connor noted in 2012 that water storage and conveyance infrastructure, though extremely expensive, can effectively build drought resilience. California has a long history with water mega-projects, and infrastructure like the Colorado River Aqueduct will remain vital for supplying water when it can't be sourced in-state. Furthermore, the CDWR's State Water Project and the USBR's Central Valley Project are the best examples of showing that California and the United States are committed to continually improving water infrastructure. States and countries with semi-arid and arid regions should note the importance of the SWP and CVP in California, along with how those projects have helped California manage its water resources during droughts.

Representing another school of thought, Medellín-Azuara and Lund, associate director and co-director at the UC Davis Center for Watershed Sciences respectively, suggest "growing water scarcity for agriculture is probably best managed using water markets and pricing so the industry and the state can make the most of limited supplies." However, local effects must be taken into account. Researchers at the Environmental Finance Center at the University of North Carolina at Chapel Hill found that during the mid 2010s California drought, no single water pricing strategy performed better than any other. Differences between strategies like tiered pricing, flat charges, and uniformed rates were found to be statistically insignificant across the

entire state (Hughes et al., 2019). Local ecosystems and populations have unique combinations of needs, and these must be taken into account when pricing water.

Furthermore, any steps to relieve water scarcity must be sustainable. This advice seems to have taken hold in California, where government agencies like the CNRA released long reports summarizing the effects of the 2012-2016 California drought and detailing steps the state needs to take for better water management during future droughts. Sustainability groups must also continue to watch water infrastructure projects to ensure governments and corporations aren't acting against public interest. Advocacy groups in California have succeeded in this by pursuing litigation on and spreading awareness about water issues, so advocacy groups in other regions should follow a similar blueprint. Groundwater, although a viable temporary solution, can easily be overdrafted. For areas with more difficult surface water sources, desalination may be a viable option. Desalination involves removing the salt content from seawater, which will be especially viable for arid coastal regions. Buck et al. (2016) note that although it is less prone to disruption, it has a higher average cost than surface water sources of equivalent production.

There are many lessons to take home from the actions of social groups during recent California droughts. Cooperation among different agencies, industries, and populations will be crucial for building water shortage resilience. Brodt et al. knew this as early as 2006, as they urged proponents of sustainability to organize interest group coalitions. Furthermore, the future steps reported by the CNRA can give other states and countries a head start on their own mitigation efforts. Much of their recommendations were specific to California, but other sovereignties can still make water rights information easily available to the public, develop tools for communicating water supply levels and drought conditions, and diversify water supply sources, to name a few. Lessons from each social group, whether it's individual almond farmers

or a government department, must be considered and combined to create effective plans for water scarcity mitigation.

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